# BOOK REVIEWS

Reinhold Bauer, James Williams, and Wolfhard Weber (eds.), *Technik zwischen artes und arts – Technology between artes and arts. Festschrift für Hans-Joachim Braun*. Münster: Waxmann Verlag, 2008, 196 pp, €24.90, ISBN 978-3-8309-2026-7

This edited volume is dedicated to Hans-Joachim Braun on the occasion of his 65th anniversary and inevitable retirement after 25 years as professor of Modern Social, Economic and Technological History at the Helmut Schmidt University (Hamburg). The contributing friends and colleagues also celebrate Braun's long-time commitment to ICOHTEC as well as his inspiring academic scholarship. Therefore they have thoughtfully chosen the two themes of this commemorative volume: i.e. technology transfer during the early history of industrialization and "the field of technology and arts, studying transtechnical influences and relations". (p. 9) Both research strands are strongly intertwined with Braun's own academic work, as demonstrated by the long list of his publications in the book's appendix.

Eleven out of the 13 articles contained – written in either German or English – are closely linked to the two fields of investigation mentioned above. The volume is completed by two essays of Volker Schmidtchen and Wolfgang König, the former on the 'cultural connotation' of military technology, the latter on the concept of technology within the academic discipline of the History of Technology.

Wolfhard Weber opens the first 'section' on early industrialization, discussing in his article the close relation between the 'mechanicus' and the 'engineer' in 18th century Germany. He uses two biographies to illustrate the transfer of practical knowledge from the traditional 'artes mechanicae' into the evolving field of civil engineering. Rainer Stahlschmidt revisits the classical case of technological transfer from England to Germany: he shows that the involvement of the Prussian state didn't stop prior 1850, as hitherto thought, but rather the state continued to subsidized the transfer of technological knowledge. The long history of knowledge transfer from Saxony to Russia is central to Friedrich Naumann's article: he focuses on the migration of Saxon mining experts and the training of Russian engineers at the mining academy in Freiberg. Timo Myllyntaus' article describes the national appropriation of technological knowledge by the popularization of electricity in Finland. From popular music to technical journals, the Finnish electrification was promoted as a national project. E.g. Book Reviews and songwriters avoiding foreign loanwords and introducing vernacular terms instead, by which they bolstered up the Finnish speaking elite: electrification as nation building.

The second 'section' covers a very broad field, thus reflecting Braun's own research interests on the relationship of arts and technology: Angus Buchanan investigates Isambard Kingdom Brunel's artistic patronage, admitting that he might have been an exception amongst early English engineers. Hartmut Knittel is interested in the aesthetic dimension of steam locomotives, while Carroll Pursell investigates the art and commerce behind the video game industry. In his paper, Reinhold Bauer describes the dual use of holography in arts and technology, at the same time addressing the subject of failed innovations – one of Hans-Joachim Braun's other research topics. In his intriguing article Edmund Todd looks upon the new trading zones of the emerging socio-technical and technopolitical systems, which evolved in the second half of the 19th century. He asks why workers in Bochum didn't adopt to gospel, jazz and blues and why workers in Bayou didn't form a strong socialist party. One of the answers, Todd gives is, that "workers develop [different] techniques for making technology work". (108) I.e., improvising jazz or blues must be seen as a kind of practical knowledge of workers, adopted to the particular rhythm of work in Bayou. Another unusual connection between work and art describes Heike Knortz's telling the fascinating story of Rudolph von Laban's way to analyze the 'industrial rhythm'. Laban, a German avant-garde ballet dancer, developed a new ballet notation, which was used during the Second World War to improve the performance of British workers. Despite the close connection between Taylorism and Laban's training methods, Laban avoided the pitfalls of 'taylorized' optimization by favouring natural movements, even if it took longer to perform them. With Laban's method "the operator would be able to sustain work throughout the shift so that at the end of the day output was increased and the worker would feel less like a robot and more like a whole person." (130) Finally Bernd Schabbing's essay closes the volume with some general reflections on the interaction of art and technology, asking for the motivation of artists to deal with technology and vice versa: why should engineers care about art? His idealistic answer is, that artists could help engineers to reflect on technology, to accept the limits of technological growth – an idea that has always been central to Hans-Joachim Braun's work.

To summarize, the book is in a way much more coherent than many other comparable volumes. All contributing Book Reviewss well connect their papers to the general theme given and the work of Hans-Joachim Braun. The only criticism left is, that a more careful editing would have avoided some unnecessary slips: like a spelling mistake in the column title (pp. 45-61) or the doubling of a sentence (88). Beside these minor quibbles, this commemorative volume is a nice bouquet of appealing articles – and, especially some of the 'art'-chapters are a great pleasure to read.

*Stefan Krebs, Eindhoven*

Deborah G. Johnson and Jameson M. Wetmore, *Technology and Society: Building Our Sociotechnical Future*. Cambridge, MA, and London: The MIT Press, 2009. xiv, 623, [3] pp. ISBN: 978-0-262-60073-6. Paperback $42/£27.95 Hardback $80/£51.95

In this collection, Deborah Johnson & Jameson Wetmore have assembled a varied and valuable set of perspectives on the relations defining social and technological change. Neither the first, nor likely the last book to be so titled, the words after the colon signal its distinctive organizing principle, situating techne and social values within the perennial metaphor of building tomorrow. Both forward looking and historical in scope it is also smartly interdisciplinary in its thematic and problem-focused structure. It is a collection that balances breadth and depth, carefully introducing readers to a range of topics and frameworks useful for understanding how technology shapes society and how society shapes technology. The clear and concise general introduction is followed by useful contextual pieces for each of the five thematic sections with guiding questions for readers. There are also helpful prefaces provided for each chapter.

The first section explores technological expectations, forecasts, and fears. Beginning with Freeman Dyson's essay on "Technology and Social Justice" and E. M. Forster's short story "The Machine Stops" it also includes chapters on nanotechnology, human reproduction and Bill Joy's 2000 *WIRED* essay: "Why The Future Doesn't Need Us." The next set of chapters consider the interplay between technology and society with Lawrence Lessig, "Code is Law," Bruno Latour on the sociology of mundane artefacts, and essays outlining the debate between technological determinism and social construction. The third section explicitly examines the technology and values link with essays on gender and military design, Richard Dyer's historical research on photographic technology as a means for enhancing the flesh tones associated with ideals of 'whiteness,' and Wetmore's article on the Old Order Amish and their use of technology as a means of preserving culture. The next section surveys complex technological systems including Harry Collins and Trevor Pinch, "The Naked Launch: Assigning Blame for the Challenger explosion" and M. Carme Alemany Gomez, "Bodies, Machines and Male Power." In the last section it's back to the future with a focus on 21st century challenges including chapters on surveillance and security, nanotechnology as an antidote to poverty, energy and environmental justice, and the final chapter "Icarus 2.0," a look ahead at human biological enhancement by historian Michael Bess.

The collaboration leading to this assemblage began at the University of Virginia where Johnson is Professor of Applied Ethics and chair of the Department of Science, Technology and Society and where Wetmore (cur-

rently assistant professor at the Consortium for Science, Policy, and Outcomes and the School of Human Evolution and Social Change at Arizona State University) completed post-doctoral work. The first of two collections by the editors it is part of MIT's 'Inside Technology' series, which is edited by Bernard Carlson, Trevor Pinch and Wiebe Pijker. Like Albert A. Teich's ground breaking Technology and Man's Future (1972) (originally drawn from the editor's Syracuse University graduate syllabus) Johnson and Wetmore have a view toward fulfilling the needs of their fellow university teachers. The collection is at the same moment a useful compilation for anyone interested in the dynamic relations defining people and technical systems/products and the different ways they are understood in popular as well as specialist discourse and scholarly venues.

In the introduction the editors argue for the necessity of dialogue and research beyond the frameworks of engineering and science to promote a better "understanding of how devices, techniques, people, institutions, goals, and values are intertwined." (p. xii). In this regard, they owe a debt to another pioneering collection, Donald MacKenzie and Judy Wajcman's The Social Shaping of Technology (1985), and indeed Wajcman is included here with an essay in the last section on the feminization of work.

Forster's short story, the only piece of literature in this collection can also be found in the late Arthur O. Lewis's (1920-2009) anthology *Of Men and Machines* (1963). An eminent Utopian Studies and Science Fiction scholar Lewis was associate dean emeritus at Pennsylvania State University where he also chaired the Science, Technology and Society program. This earlier collection included excerpts from Aldous Huxley's *Brave New World*, Orwell's *Road to Wigan Pier*, as well as Auden's Poem "The Unknown Citizen" and C. P. Snow's "Recent Thoughts on the Two Cultures." Comparing the 1963 collection to that of Johnson and Wetmore it is clear that there has been shift over the past half century or so from a primary focus on 'The Machine' and the question of 'man' as master or servant to a more dynamic view of technology, which more explicitly addresses artefacts and mechanical innovations as part of social systems that include constructions of gender and evolving human values.

In Lewis's collection nearly half of the 50-plus selections were literary with an Emily Dickinson poem being one of only two pieces by women. Teich's original edition, focused on 'man's' future contained no female authors. Retitled *Technology and the Future*, the 4th edition added Donella Meadows, lead author on "Technology and the Limits of Growth." There are certainly more women represented in this collection with three essays explicitly focused on gender and technology but it would appear that male voices remain dominant even in the ostensibly 'softer' field of technology and values.

In terms of historical range Forster's is the lone contributor from the era leading up to the First World War. The next historical stop is the 1960s with Robert Heilbroner's articulation of technological determinism in "Do Machines Make History" (1967). The 1980s are represented by Langdon Winner's "Do Artifacts Have Politics?", (1986), and Pinch and Pijker's, "The Social Construction of Facts and Artifacts" (1987), a reply of sorts to Heilbroner. The rest of the essays are drawn from the 1990s onwards. Selections are drawn from a wide range of sources: the story by Forster from the Oxford and Cambridge Review (1909); chapters from recent books such as Collins and Pinch, The Golem at Large (2002) and Francis Fukuyama's *Our Posthuman Future*. In addition there are articles from *Science, Technology & Human Values, PLoS Medicine, IEEE's Technology & Society Magazine, Science & Engineering Ethics, History & Technology*, and *Technology & Culture*.

There is an abundance of choice in this growing publishing area: from the more explicitly historical in Richard Rhodes, *Visions of Technology: A Century of Vital Debate About Machines, Systems and the Human World* (1999) to collections organized in an opposing views format such as David Haugen and Susan Musser's, *Technology and Society* (2007) and Thomas Easton's, *Taking Sides: Clashing Views in Science, Technology, and Society* (2007). Other collections include Linda S. Hjorth, Barbara A. Eichler Ahmed S. Khan, and John A. Morello, *Technology and Society: A Bridge to the 21st Century* (2002); Morton Winston and Ralph Edelbach, *Society, Ethics, and Technology* (2008); and the case studies approach of Wenda K. Bauchspies, Jennifer Croissant, and Sal Restivo, *Science, Technology, and Society: A Sociological Approach* (2005). Among these other works this collection stands out, bringing together a rich array of useful cross disciplinary essays in a clever arrangement that sketches the movement from the man-machine paradigm of the early 20th century to the post-WWII rise of technology, science and society studies and on to today's unique technological dilemmas. Less a criticism than an expression of my own research interests, I would have liked to have seen the editors' choices for a discrete section on values and changing technology in publishing and communication. Already a hefty volume, its scope remains impressive. Demonstrating the ways in which a variety of important thinkers from many disciplines engage with a whole host of issues it is suitable for use in advanced undergraduate and graduate courses in STS and topical courses in a variety of fields. I could easily envision using this anthology in an undergraduate or graduate course centred on ethics and the history of technology.

*Michael Anton Budd, Salve Regina University, Newport, Rhode Island*

Karin Bijsterveld, *Mechanical Sound: Technology, Culture, and Public Problems of Noise in the Twentieth Century*. Boston: The MIT Press, 2008, 368 pp, ISBN-13: 978-0262026390, $34.94

In her book Karin Bijsterveld looks at four main episodes of noise in Europe (notably the United Kingdom, Germany and the Netherlands) and also in the United States. The book deals with the subject of noise and the public agenda from 1875 to 1975. The focus is on industrial noise, traffic noise, noise from neighborhoods, and aircraft noise. She also looks at complaints about noise.

Bijsterveld produces an interesting table of the changing definitions of noise problems. The table also shows, for instance, how attempts at solutions to the noise problems were tried. The recurrent strategy is reducing through technical forms of noise reduction, but some noise problems were left to citizens themselves to deal with, for example, by negotiating (individualizing the problem). This Bijsterveld calls a paradox of control which means that experts and politicians promised to control some noise, but left other noise problems up to citizens.

The book contains several agreeable arguments, for instance: "The decibel only added the idea of limiting the level of sound to a particular maximum in particular areas. This, however, had constraining effects. It made it more difficult, for instance, to take the effect of the discontinuity and unexpectedness of sound into account when seeking ways to abate noise." (pp. 257) This is very true and many authorities dealing with noise problems feel that maximum decibel levels, in many cases 55dB, only makes their work more difficult since this inflexible limit forces them to overlook unexpected sounds or single and few but very loud sounds. Furthermore, decibel noise level standards do not take account of cultural or social aspects of noise and individual differences in experiencing it. The status of maximum decibel levels standards should be once more challenged now when silent areas are mapped in many EU-countries. In the current situation silence is in many times defined as less then 30 decibels, and in urban areas under 45–50 decibels where "natural silence" can not be found. But it is the difficulty of transforming citizens' experiences and wishes to numerological, relative easily operated standards or practices–they are so much "in the gray area" that experts tend to overlook it.

Bijsterveld also argues that we should enhance citizens' feelings of control by doing two things: having experts design norms that are close to the everyday experiences of citizens, and offer choice to citizens after general standards have been installed. This is a very good notion because it is many times verified in a variety of studies that a feeling of some kind of control over noise makes us adjust better to noise (to a certain point) and may even diminish the negative health effects of noise, especially stress.

*Outi Ampuja, University of Helsinki*

Hong-Sen Yan, *Reconstruction Designs of Lost Ancient Chinese Machinery*. Springer, Dordrecht, The Netherlands, 2008, pp. xii + 308, ISBN 978-1-4020-6459-3 (Print), 978-1-4020-6460-9, $109.00.

Since the 1990s there have been increasingly intensive activities in the field of the Chinese history of science and technology in China. Institutions in the People's Republic as well as in Taiwan get engaged in national research projects and in international co-operations, whereas Chinese scholars participate in increasing numbers in national and international conferences focusing on the ancient and traditional Chinese science and technology, including science and technology of minorities in China with emphasis on the ethnological perspective. In this large context also belongs the active Chinese participation in and organisation of the XXII International Congress on History of Science in Beijing (July 2005), as well as of the 3rd International Symposium on History of Machines and Mechanisms (HMM) in Tainan/Taiwan (November 2008), following the Symposium series started in 2000 in Cassino, Italy. The special focus of the HMM Symposia is the modern technical approach in the sense of reformulating the technological heritage in terms of modern scientific and technological formalism. The Proceedings of these Symposia as well as related monographs are published by Springer (The Netherlands) in the series *History of Mechanism and Machine Science*. The 3rd volume of this series is the monograph of Hong-Sen Yan dedicated to ancient Chinese machinery.

Hong-Sen Yan is Professor in the Department of Mechanical Engineering at the National Cheng Kung University of Tainan, Taiwan. He was the head of the organising committee of the 3rd International Symposium on HMM (2008) and is one of the leading figures of the modern technical approach of ancient machines. In this treatise he focuses on "lost" ancient Chinese machinery and proposes a methodology for reconstructing the design and modern rebuilding of the machines. The term "lost" refers to the lack of archaeological and ethnological evidence for the objects considered in the present study – a condition that is related to the implicit decision of the author to set aside any ethnological or archaeological parallelism or comparison.

The book is divided into eight chapters. The first chapter proposes a typology of ancient Chinese machines according to their use, as well as a classification of the objects according to the type of sources. Then the main focus of the treatise, the "reconstruction design" is presented. Several methods of analysing the presumed functioning and of reconstructing parts or the whole of ancient machines are presented shortly. The aim of the analysis is to reconstruct "all feasible designs" of the artefact considered. According to the author "[T]he purpose of reconstructing analysis is to study … subjects based on modern engineering technology", whereas "[T]he objective of reconstruction synthesis is to regenerate ancient machines that are consistent with historical records

and the levels of ancient technology and craftsmanship". In fact the author treats in the following chapters much more the analysis of design than the synthesis, and for all practical purposes does not consider at all technological prerequisites such as tools, working facilities, working organisation, etc. in the historical periods considered.

Chapter 2 introduces the (modern) terminology used for mechanisms and machines and yields an overview of modern theories concerning topological structures and structural synthesis for mechanisms. Chapter 4 introduces the reconstruction design methodology, mainly the "kinematic chains of joints" as it is used by experts in modern mechanics. These tools will be used extensively in the next chapters for describing the ancient mechanisms.

Chapter 3 describes ancient Chinese machines mainly on the basis of historical records – textual and pictorial – with occasional remarks on archaeological evidence. The typology corresponds explicitly to a modern functional perspective without any effort or intention to position the technology in the specific historical and social context in which it emerged. Characteristic is the attribute "labor-saving devices" for devices encountered in quite different periods and social environments during ca. 4000 years (pp. 45 ff.). The text offers quotations from historical documents and legends, both in English and Chinese. This can be of great help for scholars interested in identifying names of persons, devices mentioned or Chinese expressions used in conjunction with the specific devices. The reader who is not acquainted with the history of China and Chinese literature might be confused and disorientated in the jungle of names and treatises mentioned, but it is not the aim of this book to give a concise historical guide of Chinese written sources. Questions concerned with the reliability and (relative) relevance of the sources mentioned do not belong to the scope of the author and remain disappointingly open.

In the following four chapters the author applies his methods on four ancient Chinese mechanisms: the seismoscope (Chapter 5) attributed to Zhang Heng (132 CE), the escapement regulator for a water-powered clock as a part of an armillary sphere (Chapter 6) attributed to Su Song (1088 CE), south-pointing chariots (Chapter 7), and (animal) walking machines (Chapter 8). The seismoscope of Zhang Heng offers the best opportunity for the author to demonstrate his approach. The mechanical method to record earthquake motion by this historically documented device was presumably based on a certain combination of lever(s), pulley(s) and ropes. Several feasible combinations (types and numbers) of these elements are analysed and discussed by means of the proposed procedure for the reconstruction of design concepts.

The mechanism treated in Chapter 6 is the escapement regulator of the water-powered mechanical clock which was a basic part of the armillary sphere, an astronomical device situated, according to the textual and pictorial records, on a clock tower (around 1088 CE). The topological structure of a feasible design

is analysed by the author on the basis of historical records. This analysis is then used for the reconstruction of various feasible design concepts by means of the method proposed in Chapter 4.

The same procedure is followed in the treatment of the south-pointing chariots in Chapter 7. The legendary mechanism comprises a chariot with a human figure which continuously points to the south. The historical record considered is scattered over a very long period. The author's claim to study and discuss the historical background of the keen artefact remains unfulfilled. He just takes for granted that, whenever south-pointing chariots are mentioned in Chinese literature, these mysterious artefacts have been successfully designed and manufactured (p. 214). After all, sources criticism has been explicitly excluded from the scope of the study. The author quotes numerous literary sources, and claims to "reconstruct all feasible designs of south-pointing chariots that meet the scientific and technological standards of the subject's time period" (p. 199). In fact he just applies modern reasoning (including the proposed methodology of reconstructing design concepts) without any serious considerations or evidence on science and technology of the period under question.

The last considerations (Chapter 8) deal with animal-walking machines. The author focuses mainly on a wooden horse carriage attributed to Lu Ban (ca. 230 CE) and develops a series of purely hypothetic, but functionally feasible design concepts.

Epistemologically the book is inspired by the assumption that modern reasoning with respect to mechanical function can elucidate the construction of historical technological artefacts – once their existence has been assured or assumed. The author is cautious enough to propose in each case not a single but a bundle of feasible design concepts, leaving to the archaeological research the task to yield evidence needed for selecting the right proposal on the original design: "If the defined and/or concluded design specifications, topological characteristics and design requirements and constraints are feasible, one of the resulting reconstruction designs should be the original design." (p. ix) The *meaning* or the *role* of constructing the specific technological device in the specific historical/cultural context; the *variation* of these dimensions in the different periods in which the devices have been encountered – such questions do not belong to the scope of the treatise. Fortunately or unfortunately, lack of evidence and methodological gaps render history of science and technology *underdetermined*; i.e. the historian has several degrees of freedom in arranging and interpreting existing evidence – even when considering not only functional possibilities but also the historical context. This fact renders historical demonstration less rigid and historical interpretation more malleable and flexible, even more questionable, than the task of selecting among mathematical or mechanical models.

The elaborate methods used by the author for analysing the mechanisms considered (e.g. kinematic chains of joints) belong to the specialities of technical mechanics. The discussion on the methods themselves (Chapter 4), as well as on their applicability in the four case studies (Chapters 5-8) goes far beyond the scope of the present book review.

The book uses and quotes a lot of Chinese literary sources – a great benefit for the reader, whether acquainted or not with Chinese literature. It also quotes research work (e.g. dissertations) which has been conducted in the spirit and on the basis of the methodology proposed in this treatise. For readers acquainted with the generous way of J. Needham's quoting sources of several cultural frames, however, the references of Hong-Sen Yan may appear somehow eclectic or arbitrary. Some of the mechanisms described and computed analytically (e.g. the water-powered mechanical clock or the south-pointing chariots) have already been treated in respect with the question of design in previous contemporary studies on the history of science and technology in China, eventually on the basis of different approaches than in the present study. Such works are rarely quoted.

The author relies strongly on the iconography of early Chinese technological texts, among others of Tian Gong Kai Wu, a treatise from 1632 CE with a lot of information on agricultural life in rural China, which has been repeatedly edited in conjunction with numerous illustrations. Since the author does not deal with the reliability of his historical sources he also lets aside modern scholar criticism on the reliability of the pictorial information provided by this and other similar editions. Instead, he mostly interprets historical illustrations as if they were imperfect (modern) technical drawings or corrupted photographs of a "lost" reality.

Explicitly the book is intended for senior and graduate students in mechanical engineering in dealing with ancient machinery. Its clear and systematic organisation reflects the teaching experience of the author with this public. For a general scholar public the book offers an impressive and persuasive overview in special fields of ancient Chinese technology. Through its controlled length, its appealing scope and its clear structure it may render ancient Chinese technology easier accessible to the general reader, and of course to engineers and adepts of physics or mechanics, than e.g. some voluminous works on the history of ancient Chinese science and technology can do. It demonstrates that modern approaches, e.g. from the perspective of modern physics and mechanics, can have a serious contribution in *appreciating* ancient technology. In order to *understand* the role and the impact of ancient technology, however, source criticism and perspectives concerning the historical context are dearly needed.

*Constantin Canavas, Hamburg/Germany*

Jerry Liu and Kent Deng, eds., "Special Issue: Chinese Technological History: The Great Divergence," pp. 1-101, and Lissa Robert and Ian Inkster, "Special Issue: The Mindful Hand," pp. 103-211. In: Ian Inkster (ed.): *History of Technology 29* (2009), : Continuum International Publishing Group, 232 pp, ISBN 9781441136114, £90.00, $180.00

The 2009 volume of *History of Technology* is dedicated to two issues: Problems relating the technical and societal development of Imperial China are discussed in the first part, the second part analyses links between knowledge and technical development in early modern Europe.

The first issue's point of departure was the great divergence of the Chinese and the European development of production technologies in 18th and 19th centuries. Why was there no Industrial Revolution in China, although the level of science and technology had been so impressive for European researchers of the enlightenment? Following Needham, traditional Western explanations argued with a general cultural inwardness of China and the inflexibility of the imperial government whereas the contributions to this volume focus on developments in China and point out that technological development did not so much fail, but followed paths different from Europe. In fact, Europeans of those times undertook unusual steps in technology and society. Patrick O' Brien, Jerry Liu, Kent Deng and Harriet Zurndorfer focus on the question how useful and reliable knowledge was generated in China and to what degree it was transferred from Europe.

O' Brien analyses what he calls the Needham Puzzle: he investigates the impact of Confucianism on the development of science and technology. His paper focuses on the Confucian's attention to the regulation of human behaviour and how to overcome societal tensions. This was – as the author argues – seen as more important than to study nature and to improve productivity. Thus, tensions between political stability and intellectual creativity were avoided in China whereas these tensions had been fruitful for the development of Europe. Jerry Liu investigates cultural approaches behind the regime of useful and reliable knowledge in the Ming and early Qing Dynasty. He makes the point that the aggressive and imperialist behaviour of the Europeans was regarded as an inability to master their own scientific and technological development by establishing a useful system of moral and ethics. This demonstrated the uselessness of European knowledge to the Chinese (p. 51). Harriet Zurndorfer studies the transfer of knowledge from Europe to China from 1600 to 1800. She underlines how important the Jesuits were for the picture of Europe at the Chinese Court and analyses their politics of knowledge transfer to China: due to their own world view they referred to many outdated works; Newton for example was not translated into Chinese. As a result European science did not seem to be of much interest. Kent Deng deals with the ques-

tion of which social groups promoted the scientific development of China and the diffusion of knowledge from Europe in the Ming and Qing periods. He focuses on the Jesuits and explains why their efforts reached only the Imperial Court and thus remained more or less in an ivory tower. A new group of elites emerged after the Opium Wars; they promoted not only the transfer of science and technology from Europe but introduced the concept of Social Darwinism. On the one hand they were opposed to the high ethical standards of the country and on the other hand they established groundwork for the modernization of society and economy in-between the 1840s and the 1890s. As result the special issue contributes substantially to the Great Divergence Debate, a perennial topic in the study of Chinese history.

In the second special issue of the 2009 *History of Technology* volume, four different case studies and a generalizing afterword by Ian Inkster are dedicated to the concept of the Mindful Hand. The authors analyse how skill, tacit knowledge and scientific approaches were combined before the Industrial Revolution to promote science as well as in order to develop technical artefacts. Alette Fleischer compares two different approaches to crystals at the end of the 17th century. The same kind of crystal rocks from a mine in Germany were used as sophisticated decoration in a garden cave, the Grotto of Ganymede in Zorgvliet near The Hague, and analysed by the mathematician Christiaan Huygens, who was interested in laws of their refraction of light. Although the aims – material production and knowledge production – were different, the grotto's architect and Huygens exploited tacit and scientific knowledge in a similar manner. Chandra Mukerji's case study is on the construction of an eight-lock-staircase for the French Canal du Midi (connecting the Atlantic Ocean and the Mediterranean See) in 1678/79. The contract for this rather complicated piece of engineering was given to two illiterate brothers who made subcontracts with local peasants. Due to their experience in timber drift they had knowledge of hydraulics and dam building which was important for the construction of the staircases. Whereas the first case study delt with a combination of tacit knowledge and scientific knowledge, the second one was dedicated to tacit knowledge which replaced engineer's knowledge. The third case study, written by Simon Werrett, analyses different types of knowledge exemplified by one person, the Russian clock-maker, bridge builder and supervisor of the Academy of Science's instrument-making workshops in St Petersburg, Ivan Petrovich Kulibin (1735-1818). The last case study, written by the co-editor of this issue, Lissa Roberts, opens the perspective of the 'Mindful Hand' to countries outside Europe. Her example is the Dutch-Japanese trade in the second half of the 18th century. She analyses the way in which European goods were adapted by Japanese workmen and demonstrates that these goods were not only consumed but redesigned in order to fit in Japanese culture. Her study exemplifiers, that natural inquiry

and invention of the 17th and 18th centuries are based on an intimate and active collaboration between mental and manual labour in Europe as in Japan. Ian Inkster argues for an international comparison as well: he makes the point that the concept of the 'Mindful Hand' actually offers a well fitting frame for evaluating local differences of innovation processes around the world. In his opinion it is suitable for investigating the past as well as the future. The contributions to the second special issue made clear that the 'Mindful Hand' is a universal concept, which is suitable to be applied to many different cases on a micro-level as well as on a macro-level. To sum up, the 2009 volume of *History of Technology* offers a collection of inspiring papers concerning the influence of knowledge on technical development.

*Stefan Poser, Hamburg*

Stefan Krebs, "Technikwissenschaft als Soziale Praxis: Über Macht und Autonomie der Aachener Eisenhüttenkunde 1870 – 1914", *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte*, Volume 204. Stuttgart: Steiner-Verlag, 2009.

The author analyses the development of scientific approaches to technology at the end of the long 19th century; the focus is on the mutual influences of scientific, social and political developments. Krebs based his book on a case study: he investigates the development of research about and the teaching of ferrous metallurgy at Aachen Technical University, which hosted the most important German institute of iron metallurgy in the first decades of the 20th century. The author places his story into the context of the origins of ferrous metallurgy as an academic subject in Germany and gives a micro-historical study of the development of academic reputation and academic power. His main questions are dedicated to (i) the development of the academic subject ferrous metallurgy, (ii) the reasons for the rapid rise of the Aachen institute, and (iii) the construction of social reality by mediating and accepting the Aachen institute's success.

The main emphasis of the book is on the role of the second professor of ferrous metallurgy in Aachen, Fritz Wüst, who succeeded in establishing his field as an academic subject and in promoting the institute of ferrous metallurgy as the most important place for research in Germany. Krebs employs a methodology to analyze Wüsts strategies with special reference to Pierre Bourdieu and to the Dresden School of History of Technolocical Sciences, which is well known in Germany for its theoretical approaches to the development of academic subjects. When Wüst took up his position at Aachen Technical University in 1901 there was a remarkable gap between the theory of ferrous metallurgy taught at university and the practice of making iron in steel works. The processes of iron melting were still based more on the

empirical knowledge of the workers and early engineers than on the results of scientific research. When the Aachen institute set up a new curriculum Wüst managed to integrate the wishes of the engineers of the steel works companies and their association, the Verein deutscher Eisenhüttenleute (VDEh) in this curriculum. On the other hand he made it clear to the VDEh and the companies that scientific knowledge was absolutely essential for processing steel correctly. Krebs sees this process as a symbolic struggle between Wüst and the VDEh. The 'great reform of ferrous metallurgic engineering' – as it was called later – aimed at making technological education specialized, mediating advanced knowledge about ferrous metallurgy and thus emancipating the field from organic and analytical chemistry; in respect to the VDEh's interests, knowledge about machinery and technology as well as laboratory courses were integrated. As a result the Aachen reform was adopted by the other German Institutes of Technology. The consolidation of the academic subject ferrous metallurgy succeeded and changed practices in German steel works fundamentally. Aachen educated more than 50 % of the German ferrous metallurgy engineers after the curriculum was inaugurated and laboratories were enlarged in-between 1904 and 1906 whereas other important technical universities like Berlin and Breslau (today Wroclaw) lost ferrous metallurgy students.

The outstanding position of ferrous metallurgy at Aachen Technical University is a good reason to write a case study on Aachen instead of a comparison between different Institutes of Technology. Krebs's detailed book is based on meticulous research in several archives and offers a new perspective on the development of scientific approaches to technology.

*Stefan Poser, Hamburg*

Gunter Gebauer, Stefan Poser, Robert Schmidt and Martin Stern (eds.), *Kalkuliertes Risiko: Technik, Spiel und Sport an der Grenze*. Frankfurt, New York: Campus Verlag, 2006, 305 pp., ISBN: 978-3593380063, €29.90

Stefan Poser, Joseph Hoppe and Bernd Lüke, *Spiel mit Technik*. Leipzig: Koehler & Amelang, 2006, 239 pp., ISBN-13: 978-3733803537, €19.95

When most people think about play they are scarcely concerned with technological invention or hazardous enterprise. Even though since the time of Johan Huizinga's Homo ludens most of us would know that play is a fundamental element of culture we hardly expect to discover play elements in the course of scientific progress or technological breakthroughs. The grand narrative of modern history of technology still insists that airplanes, computers or the organization of large industrial facilities are the results of hard labour, human intelligence and infinite patience and not the outcome of some kind of childish entertainment.

Thanks to the German Historian of Technology, Stefan Poser, the situation

has been changing for a couple of years. Poser has organized at least a dozen events, panels on annual conferences, lecture series, exhibitions, etc., where he invited colleagues from various disciplines to reflect on the diverse and complex relations between play and technological enterprises. The latest outcome of his activities are two publications, one about play, technology and risk, edited together with G. Gebauer, Robert Schmidt and Martin Stern, the other about playing with technology, edited together with Joseph Hoppe and Bernd Lüke.

*Kalkuliertes Risiko. Technik, Spiel und Sport an der Grenze* reflects on the very interesting differences and correspondences between risk and playful entertainment. In the first part, "Exposition", Poser defines the conceptual foundations and embeds the notions of play, technology and risk into the wider horizon of history of technology. In his central thesis he proposes that play opens up new perspectives on technological development and the cultural management of risk and that it is especially the play element of ilinx, vertigo, Roger Caillois' forth category in the world of play, that dominates the situation.

The second part of the book is concerned with the manifold ways modern man has been experimenting with technology or technological devices. New modes of movement and new forms of self-presentation have sprung up from that which is shown by the example of hazardous sports like mountain climbing (Stefan Kaufmann) or paragliding (Martin Stern) and in the ficticious role-play worlds of the Internet (Volker Wolterdorff). The topic of movement is dealt with in further detail in the third chapter, which concentrates on new experiences with speed and vertical motions. Both came about with the rise of automobiles (Wolfgang König) and aeroplanes (Christian Kehrt). The last part bears the beautiful titel "Eigenwelten", which elegantly undermines the old and false dichotomy between play and seriousness/labour/reality, etc. In my view it is the most innovative part of the book as it reveals strikingly new aspects of playful interaction with technology. In "High-Tech Gespür – Spiel und Risiko in der erfahrungsgeleiteten Anlagensteuerung" Fritz Böhle reports on his empirical research on the playful dimensions of working with complex technical systems in the chemical industry. Petra Schaper-Rinkel reconstructs the historical development of nanotechnologies and identifies the different protagonists as players in a risky competition about political and economic power. Finally, Katja Rothe describes the dramatizing of ficticious catastrophes in the early years of the radio. All three articles convincingly show how technological development is dependent on an environment of play areas which follow their own logic.

*Spiel mit Technik* is an exhibiton catalogue which covers a special show at the Deutsches Technikmuseum 2006 – 2007 in Berlin. The underlying concept assumes that first play creates free spaces for technical innovation and new modes of dealing with technology. Second, the playful handling promotes a positive attitude towards technology and third, the relation between play and technology

characterizes historical times and places. One must admit that this is a sensible, but also unspecific way to treat the topic. Consequently the book comprises a wide range of playthings, toys, games, optical illusions and sports equipment, which illustrates a possible, but by no means obligatory scenario. But maybe this is the fate of all books about play which try to deliver some kind of compendium of the topic. One still likes to run over the pages and discover nice curiosities like Bobby-Car-Races and a Robot-Mud-Coffee-Systems.

*Natascha Adamowsky, Humboldt Universität, Berlin*

Edward J. Hackett, Olga Amsterdamska, Michael Lynch and Judy Wajcman (eds.), *The Handbook of Science and Technology Studies 3rd Edition*. Cambridge MA, and London: The M.I.T. Press, 2008, 1065 pp, ISBN 978-0262083645, $58.00

How does one do justice, in the space of a brief review, to a production of over 1,000 pages, bringing together the work of no less than 85 authors presenting their work in some five prefaces and thirty-eight papers? Manifestly some kind of sampling procedure has to be the answer, although the richness of the offerings requires something to be said by way of preface. If a book is to be judged by the degree of intellectual stimulation it provokes, then this book scores very highly. Furthermore, whatever it is that one may be seeking to find here will almost certainly found to be present. However, I mention this with some reservations, as will become clear below. I have also to sound one or two negative notes. Some of the papers suffer from such a high degree of compression as to border on the opaque and/or resemble some sort of bibliographical shorthand. Furthermore, there is a marked imbalance, as far as may be judged from the brief biographical accounts offered by the authors at the end of the volume, as between those who may be broadly described as historians of technology and those primarily interested in the history of science and medicine and their contemporary social settings. The ratio appears to be something like 1:3. This is unfortunate, for it seems to me that it is the global human technoscientific environment and its conflictual stance vis-à-vis the natural environment, properly understood, that presents the most critically urgent problems we confront. There is no need to rehearse these since, flat-earthers aside, they are virtually universally acknowledged.

But to the sample. Steven Shapin, in his "Science and the Modern World" suggests very strongly that it is irrationality, not science, that shapes the thinking of the vast majority of people, even when one narrows the focus down to graduates and the scientists themselves. "The percentage of these elites (i.e. those with masters or doctoral degrees) who say they believe in miracles is only 72 per cent" – that is, compared to the 85 per cent of the population at large. The evidence Shapin adduces for these figures relates to the USA but probably

reflects the situation in Europe also. He concludes that "…the problem of the independent authority of science in our modern world… [is] a problem in our modern order of things…what to believe, whom to trust, what to do."

This leads directly to Charles Thorpe writing on "Political Theory in Science and Technology Studies". Although his paper is inescapably a mapping exercise and is thereby rendered so highly abstract as to be likely to deter those not already au fait with the nature of the discourse he is surveying yet, it is, I believe, one of the most important contributions to the book. The basic question addressed is how best to secure rational foundations for a cognitive and social order, or to be concrete how best to render expertise compatible with liberal-democratic political structures. Michael Polanyi believed that the social order of science was isomorphic with the capitalist free market yet the free market produces change, not to say wave upon wave of Schumpeterian creative destruction which the scientist and technologist are ultimately the producers of. How then, is change to be made amenable to society? And what might be the nature of the democratic controls that might conceivably be strong enough to be capable of assessing, or even stopping, what is coming down the pipeline? The unforeseen consequences of every human action, and a fortiori of technoscientific action make the problem of democratic control the number one priority.

But going back to the imbalance mentioned above as between technology on the one hand and science and medicine on the other, one must ask where is a matching contribution to Steven Shapin's paper on "Science and the Modern World", something that would be along the lines, say, of "Technology and the Modern World"? The nearest one gets to this is Sally Wyatt's "Technological Determinism is Dead; Long Live Technological Determinism", to which I turn next. Wyatt identifies four varieties:

Justificatory. This is largely deployed by actors. It is all around us. It is the type, as Wyatt writes, used by employers to justify downsizing and reoganisation.

Descriptive. The attraction of this type of technological determinism is that it does in fact afford "quite a good description of the historical record." It is certainly difficult to imagine our own society without considering also the technological armature holding it together.

Methodological. Here, to quote Wyatt, what is going on is an attempt "… to understand the role of technology in history and in contemporary social life; actor – network theory, social constructivism, history of technology, and innovation theory all take technology seriously."

Normative. This is the view held by those who consider that technology has grown so big and so complex that it is no longer amendable to social control at all.

As to all this, Wyatt's own view is that the methodological approach is nothing more than the attempt develop tools for understanding the place of technology in history. This is what she believes everyone in science and technology studies

is in fact doing: "My provocation here is that our guilty secret in STS is that really we are all technological determinists. If we were not, we would have no object of analysis; our raison d'être would disappear". The plea here is really to take technological determinism seriously so as to be better able to conceptualize the dialectical relationship between the social shaping of technology and the technological shaping of society. Only then shall we have the tools that will permit us to participate in creating a more democratic sociotechnical order. Put more simply, if technology drives history, then what drives technology can only be homo faber himself acting in numbers.

The need for such a democratic, sociotechnical order emerges very clearly in the final paper of my sample: Steven Yearley's "Nature and the Environment in Science and Technology Studies." As he writes, "It is now evident that the environment is critical to STS…because studying it affords a key insight into the status of 'the natural' in advanced modernity": 'the natural' is so presented because, to an astonishing degree in Europe at least, the countryside is man-made and therefore more or less wholly unnatural. In the debate over climate change, for example, the very complexity of the relationship between knowledge and policy formation has made this a major area for STS research alongside genetic modification and GM plants and food. The intricacy of the evolving debate here can perhaps best be illustrated by the fact that, as Yearly writes, "The distinctive difficulty in this case [i.e. that U.S. testing has not been precautionary enough] is that, by and large, the official expert scientific communities on opposing sides [in this debate the Europeans are on the other side] take diametrically opposing views." Furthermore, these differing views "…appear to be tantamount to incommensurable paradigms for assessing the safety and suitability of GM crops. There is no higher level of scientific rationality or expertise to which appeal can be made to say which approach is correct…". In Britain the quasi covert attempts of the government to introduce such crops raises again the question of how debate (let alone control) in a supposedly liberal-democratic state is to be guaranteed, and by what means "accountability" is to become meaningful. This, of course, is almost where we began. About 1680 Gottfried Liebniz remarked that if states were to combine their efforts, science would advance more quickly but the situation obtaining in reality put him in mind more of "a disorderly rabble marching in the darkness."[1] Dennis Gabor, writing in 1963, really sums up the crux of the matter: "Till now, man has been up against nature; from now on he will be up against his own nature."[2]

*Graham Hollister-Short, Imperial College, London*

**NOTES**

1. G. W. Leibniz, *Philosophical Writings* (trans. M. Monroe), London 1934, pp 237-8. The phrase is from an undated paper entitled, 'Precepts for advancing the sciences'.
2. D. Gabor, *Inventing the Future* (London, 1963) p. 185